

U.S. Patent Appln. No. 10/726,759
Amendment
Reply to Office Action dated March 22, 2005

Docket No. 9665-1

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Cancelled)
2. (Currently amended) The stage according to claim 1, A 3-axis straight line motion stage comprising:
 - a bottom plate having a predetermined area and thickness;
 - an X-axis stage fixed in a reference area of the bottom plate, for moving in the direction of the X-axis, a first X area positioned from the reference area to the direction of the X-axis;
 - a Y-axis stage, positioned within the first X area and fixed in a second X area, which is located within the first X area for moving in the direction of the Y-axis a second Y area positioned from the second X area to the direction of the Y-axis; and
 - a Z-axis stage fixed in the second Y area, which is located within the first Y area and supports a predetermined sample for moving the sample in the direction of the Z-axis;
 - wherein the X-axis stage (10) comprises comprising:
 - a piezoelectric element having a predetermined length, the length being changed in the direction of the Y-axis according to an input voltage[.];
 - and a first X driving part (11-1) and a second X driving part (11-2) connected to both ends of a longitudinal direction of the piezoelectric element (13), respectively, for moving in the X-axis direction the a second X end (16-2) within the first X area (11-1) from a first X end (16-1) within the reference area (RR) in the center of the piezoelectric element (13) according to driving of the piezoelectric element (13),
 - wherein the X-axis, the Y-axis and the Z-axis indicate axes of rectangular coordinates, respectively.

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3. (Currently amended) The stage according to claim ~~[[1]]~~ 2, wherein the first and second X driving parts ~~(11-1, 11-2)~~ comprise~~[[s]]~~ first and second X amplifying parts ~~(12-1, 12-2)~~ amplifying a displacement generated according to the driving of the piezoelectric element, ~~(13)~~ and moving third and fourth ~~fourth~~ X ends ~~(16-3, 16-4)~~ formed ~~in the opponent~~ on a side opposite to side of the first X end ~~(16-1)~~ in the center of the piezoelectric element, in the direction of ~~the~~ X-axis by the amplified displacement,

first and second X-line motion parts ~~(13-1, 13-2)~~ shifted in parallel in the direction of ~~the~~ X-axis by the amplified displacement,

first and second slits ~~(19-1B, 19-1C)~~ connecting the third and fourth X ends ~~(16-3, 16-4)~~ to first ends of the first and second X-line motion parts ~~(13-1, 13-2)~~, respectively, and

a third slit ~~(19-1A)~~ connecting ~~the other a second end opponent opposite~~ to the first end of the first X-line motion part ~~(13-1)~~, which is connected to the third X end, ~~(16-3)~~ to ~~the other a second end opponent opposite~~ to the first end of the second X-line motion part (13-2), which is connected to the fourth X end ~~(16-4)~~.

4. (Currently amended) The stage according to claim 3, wherein the first and second X amplifying parts ~~(12-1, 12-2)~~ comprise~~[[s]]~~ first and second pressing parts ~~(14-1, 14-2)~~ receiving the displacement of the piezoelectric element, ~~[[an]]~~ intermediate rods formed in the longitudinal direction of the piezoelectric element towards the both sides of the first and second pressing part ~~(14-1, 14-2)~~ in the center of the respective first and second pressing parts ~~(14-1, 14-2)~~, and fourth and fifth slits connecting ~~the first and second pressing parts (14-1, 14-2) to the other ends opponent to the ends of the intermediate rods (15-1)~~ each other, respectively.

5. (Currently amended) The stage according to claim 4, wherein the intermediate rod comprises a post part ~~(15-A)~~ formed to have a predetermined width, and a narrowing part ~~(15-1B)~~ having a thickness relatively thinner than the width of the post part by a semicircular groove ~~(15-1C)~~ having a predetermined radius in both ends of the post part ~~(15-1A)~~.

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6. (Currently amended) The stage according to claim 5, wherein the respective first and second X amplifying parts ~~(12-1, 12-2)~~ further comprise[[s]] a hole ~~(18-1)~~ of a predetermined magnitude in the area surrounded by the fourth and fifth slits, the first pressing part ~~(14-1)~~ and the intermediate rod ~~(15-1)~~.

7. (Currently amended) The stage according to claim 6, wherein the first and second X-line motion parts ~~(13-1, 13-2)~~ comprise[[s]] first and second X double springs ~~(13-1B, 13-2B)~~ connected to the third and fourth X ends ~~(16-3, 16-4)~~ through the first and second slits ~~(19-1B, 19-1C)~~, and third and fourth X double springs ~~(13-1A, 13-2A)~~ connected to the first and second X double springs ~~(13-1B, 13-2B)~~ through a pair of slits ~~(19-1D, 19-1E)~~ having a predetermined length and formed in the parallel direction about the X [[]]axis, the ends of the third and fourth X double springs ~~(13-1A, 13-2A)~~ being connected to each other through the third slit ~~(19-1A)~~.

8. (Currently amended) The stage according to claim 7, wherein the respective first to fourth X double springs ~~(13-1B, 13-2B, 13-1A, 13-2A)~~ comprise[[s]] two intermediate rods arranged doubly, the respective intermediate rods ~~comprising~~ comprise a post part ~~(13-1C)~~ having a predetermined width, and a narrowing part having a thickness relatively narrower than the width of the post part by a semicircular groove having a predetermined radius in both ends of the post part ~~(15-1A)~~.

9. (Currently amended) The stage according to claim 3, wherein the first and second X-line motion parts ~~(13-1, 13-2)~~ comprise[[s]] first and second X double springs ~~(13-1B, 13-2B)~~ connected to the third and fourth X ends ~~(16-3, 16-4)~~ through the first and second slits ~~(19-1B, 19-1C)~~, and third and fourth X double springs ~~(13-1A, 13-2A)~~ connected to the first and second X double springs ~~(13-1B, 13-2B)~~ through a pair of slits ~~(19-1D, 19-1E)~~ having a predetermined length and formed in the parallel direction about the X [[]]axis, the ends of the third and fourth X double springs ~~(13-1A, 13-2A)~~ being connected to each other through the third slit ~~(19-1A)~~.

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10. (Currently amended) The stage according to claim 9, wherein the respective first to fourth X double springs (~~13-1B, 13-2B, 13-1A, 13-2A~~) comprise[[s]] two intermediate rods arranged doubly, the respective intermediate rods ~~comprising~~ comprise a post part (~~13-1C~~) having a predetermined width, and a narrowing part having a thickness relatively narrower than the width of the post part by a semicircular groove having a predetermined radius in both ends of the post part (~~15-1A~~).

11. (Currently amended) The stage according to claim 2, wherein the Y-axis stage (~~20~~) comprises a piezoelectric element having a predetermined length, the length being changed in the direction of the X-axis according to an input voltage, and a first Y driving part (~~21-1~~) and a second Y driving part (~~21-2~~) connected to both ends of a longitudinal direction of the piezoelectric element (~~23~~), respectively, and fixed to ~~the~~ a first Y end (~~26~~) of the second X area (~~RX2~~) for moving ~~the~~ a second Y end (~~26~~) ~~opponent~~ opposite to the first Y end (~~25~~) in the Y-axis direction on the basis of the piezoelectric element (~~23~~).

12. (Currently amended) The stage according to claim 11, wherein the Z-axis stage (~~30~~) comprises a bottom part (~~34~~) having a predetermined area and thickness and ~~fixing~~ fixed within the second Y area (~~RY2~~) of the Y-axis stage (~~20~~), a Z-line driving part (~~31~~) moving in the direction of the Z-axis and formed integrally to the bottom plate (~~34~~) in the vertical direction, which is the direction of the Z-axis, from the surface of the bottom plate (~~34~~), and a piezoelectric element (~~33~~) mounted to have a decreased or increased length in the direction of the Z-axis in ~~the~~ a space (~~31-1~~) of a predetermined size, the space being a region to which the bottom part (~~34~~) and the Z-line driving part (~~31~~) are adjacent and formed in the Z-[[axis]]line driving part (~~31~~).

13. (Currently amended) The stage according to claim 2, wherein the Z-axis stage (~~30~~) comprises a bottom part (~~34~~) having a predetermined area and thickness and ~~fixing~~ fixed within the second Y area (~~RY2~~) of the Y-axis stage (~~20~~), a Z-line driving part (~~31~~) moving in the direction of the Z-axis and formed integrally to the bottom plate (~~34~~) in the vertical direction, which is the

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direction of the Z-axis, from the surface of the bottom plate (34), and a piezoelectric element ~~(23)~~ mounted to have a decreased or increased length in the direction of the Z-axis in ~~the~~ a space ~~(31-1)~~ of a predetermined size, the space being a region to which the bottom part (34) and the Z-line driving part ~~(31)~~ are adjacent and formed in the Z-~~[[axis]]~~line driving part ~~(31)~~.

14. (Currently amended) The stage according to claim ~~[[1]]~~ 2, wherein the Y-axis stage (20) comprises a piezoelectric element having a predetermined length, the length being changed in the direction of the X-axis according to an input voltage, and a first Y driving part ~~(21-1)~~ and a second Y driving part ~~(21-2)~~ connected to both ends of a longitudinal direction of the piezoelectric element (23), respectively, and fixed to ~~the~~ a first Y end (26) of the second X area ~~(RX2)~~ for moving ~~the~~ a second Y end (26) ~~opponent~~ opposite to the first Y end (25) in the Y-axis direction on the basis of the piezoelectric element (23).

15. (Currently amended) The stage according to claim 14, wherein the first and second Y driving parts ~~(21-1, 21-2)~~ comprise~~[[s]]~~ first and second Y amplifying parts ~~(21-1, 22-2)~~ connected to both ends of a longitudinal direction of the piezoelectric element (23), respectively, for amplifying a displacement generated according to the driving of the piezoelectric element (23) and for moving the second Y end (26) in the direction of the Y-axis by the amplified displacement, and first ends of first and second Y-line motion parts ~~(23-1, 23-2)~~ connected to the first and second Y amplifying parts ~~(22-1, 22-2)~~, respectively, through ~~the~~ first and second slits ~~(27-1, 27-2)~~ traversing a part of the first Y end (26) and shifted in parallel in the direction of the Y-axis by the amplified displacement, ~~the other~~ second ends ~~opponent~~ opposite to the first ends of the first and second Y-line motion parts ~~(23-1, 23-2)~~ connected to the first and second amplifying parts ~~(22-1, 22-2)~~ being connected to each other by ~~the~~ a third slit ~~(27-3)~~.

16. (Currently amended) The stage according to claim 15, wherein the respective first and second Y amplifying parts ~~(22-1, 22-2)~~ comprise~~[[s]]~~ first and second pressing parts ~~(24-1, 24-2)~~ receiving the displacement of the piezoelectric element 23, and an intermediate rod formed
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in both sides of the first and second pressing parts ~~(14-1, 14-2)~~ symmetrically to the X-axis in the center of the respective first and second pressing parts ~~(14-1, 14-2)~~, the intermediate rod ~~(24)~~ comprising a post part having a predetermined width, and a narrowing part having a thickness relatively narrower than the width of the post part formed by a semicircular groove having a predetermined radius in both ends of the post part.

17. (Currently amended) The stage according to claim 16, wherein the first and second ~~[[X]]~~Y-line motion parts ~~(23-1, 23-2)~~ comprise first and second Y double springs connected to the first and second Y ends through the first and second slits ~~(27-1, 27-2)~~, and third and fourth Y double springs connected to the first and second Y double springs through a pair of slits having a predetermined length and formed in the parallel direction about the Y-axis, the ends of the third and fourth Y double springs being connected to each other through the third slit ~~(27-3)~~.

18. (Currently amended) The stage according to claim ~~[[1]]~~ 2, wherein the Z-axis stage comprises a bottom part ~~(34)~~ having a predetermined area and thickness and ~~fixing~~ fixed within the second Y area ~~(R-Y2)~~ of the Y-axis stage ~~(20)~~, a Z-line driving part ~~(31)~~ moving in the direction of the Z-axis and formed integrally to the bottom plate ~~(34)~~ in the vertical direction, which is the direction of the Z-axis, from the surface of the bottom plate ~~(34)~~, and a piezoelectric element ~~(32)~~ mounted to have a decreased or increased length in the direction of the Z-axis in ~~the~~ a space ~~(31-1)~~ of a predetermined size, the space being a region to which the bottom part ~~(34)~~ and the Z-line driving part ~~(31)~~ are adjacent and formed in the Z-~~[[axis]]~~line driving part ~~(31)~~.

19. (Currently amended) The stage according to claim 18, wherein the Z-line driving part ~~(31)~~ comprises first and second Z-axis motion parts ~~(31-1, 31-2)~~ moving ~~the~~ a first Z end ~~(36)~~ positioned in the direction of the Z-axis from the bottom part ~~(34)~~ to the Z-axis on the basis of the piezoelectric element according to the driving of the piezoelectric element ~~(32)~~, wherein the respective first and second Z-axis motion parts ~~(31-1, 31-1)~~ include~~[[s]]~~ the first and second Z double springs ~~(31-1A, 31-1B)~~ and the third and fourth Z double springs ~~(31-2A, 31-2B)~~ arranged

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in the direction of the Z-axis, the ends of the first and third Z double springs being ~~connection~~
connected through ~~the~~ a fourth slit (35).

20-21. (Cancelled)

22. (Currently amended) ~~The device according to claim 21;~~ A sample test device using
a 3-axis straight line motion stage, the device comprising:

a 3-axis straight line motion stage supporting a predetermined sample and shifting the
sample independently, precisely and exactly in the direction of the X-axis, the Y-axis or the Z-axis;
and

an atom microscope provided with the 3-axis straight-line motion stage for measuring the
location of the sample using a laser and for scanning the sample;

the 3-axis straight line motion stage comprising:

a bottom plate having predetermined area and thickness;

an X-axis stage, fixed in a reference area of the bottom plate, for moving in the direction of
X-axis a first X area positioned from the reference area to the direction of the X-axis;

a Y-axis stage positioned within the first X area and fixed in a second X area, which is
located within the first X area, for moving in the direction of the Y-axis a second Y area positioned
from the second X area to the direction of the Y-axis; and

a Z-axis stage fixed in the second Y area, which is located within the first Y area and
supports a predetermined sample for moving the sample in the direction of the Z-axis.

wherein the Y-axis stage comprises comprising:

a piezoelectric element having a predetermined length, the length being changed in the
direction of the X-axis according to an input voltage, and a first Y driving part (21-1) and a second
Y driving part (21-2) connected to both ends of a longitudinal direction of the piezoelectric
element (23), respectively, and fixed to the a first Y end (26) of the second X area (RX2) for
moving the a second Y end (26) opposite opposite to the first Y end (25) in the Y-axis direction on
the basis of the piezoelectric element (23).

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wherein, the X-axis, the Y-axis and the Z-axis indicate axes of rectangular coordinates, respectively.

23. (Currently amended) The device according to claim 22, wherein the Z-axis stage comprises;

a bottom part (34) having a predetermined area and thickness and ~~fixing~~ fixed within the second Y area (~~R-Y2~~) of the Y-axis stage (20),

a Z-line driving part (31) moving in the direction of the Z-axis and formed integrally to the bottom plate (34) in the vertical direction, which is the direction of the Z-axis, from the surface of the bottom plate (34), and

a piezoelectric element (33) mounted to have a decreased or increased length in the direction of the Z-axis in ~~the~~ a space (31-1) of a predetermined size, the space being a region to which the bottom part (34) and the Z-line driving part (31) are adjacent and formed in the Z-~~[[axis]]~~line driving part (31).

24. (Cancelled)